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SEQUENCE LISTING

<110> Meakin, Susan, Oriole
Volkening, Kathryn, Elizabeth

<120> METHOD OF PROLIFERATING PRECURSOR CELLS

<130> 93764-1

<150> US 60/549,870
<151> 2004-03-04

<160> 8

<170> PatentIn version 3.3

<210> 1
<211> 492
<212> PRT
<213> human

<220>
<221> misc_feature
<223> FRS3 from human

<400> 1

Met Gly Ser Cys Cys Ser Cys Leu Asn Arg Asp Ser Val Pro Asp Asn
1 5 10 15

His Pro Thr Lys Phe Lys Val Thr Asn Val Asp Asp Glu Gly Val Glu
20 25 30

Leu Gly Ser Gly Val Met Glu Leu Thr Gln Ser Glu Leu Val Leu His
35 40 45

Leu His Arg Arg Glu Ala Val Arg Trp Pro Tyr Leu Cys Leu Arg Arg
50 55 60

Tyr Gly Tyr Asp Ser Asn Leu Phe Ser Phe Glu Ser Gly Arg Arg Cys
65 70 75 80

Gln Thr Gly Gln Gly Ile Phe Ala Phe Lys Cys Ser Arg Ala Glu Glu
85 90 95

Ile Phe Asn Leu Leu Gln Asp Leu Met Gln Cys Asn Ser Ile Asn Val
100 105 110

Met Glu Glu Pro Val Ile Ile Thr Arg Asn Ser His Pro Ala Glu Leu
115 120 125

Asp Leu Pro Arg Ala Pro Gln Pro Pro Asn Ala Leu Gly Tyr Thr Val
130 135 140

Ser Ser Phe Ser Asn Gly Cys Pro Gly Glu Gly Pro Arg Phe Ser Ala
145 150 155 160

Pro Arg Arg Leu Ser Thr Ser Ser Leu Arg His Pro Ser Leu Gly Glu
165 170 175

Glu Ser Thr His Ala Leu Ile Ala Pro Asp Glu Gln Ser His Thr Tyr
180 185 190

Val Asn Thr Pro Ala Ser Glu Asp Asp His Arg Arg Gly Arg His Cys
195 200 205

Leu Gln Pro Leu Pro Glu Gly Gln Ala Pro Phe Leu Pro Gln Ala Arg
210 215 220

Gly Pro Asp Gln Arg Asp Pro Gln Val Phe Leu Gln Pro Gly Gln Val
225 230 235 240

Lys Phe Val Leu Gly Pro Thr Pro Ala Arg Arg His Met Val Lys Cys
245 250 255

Gln Gly Leu Cys Pro Ser Leu His Asp Pro Pro His His Asn Asn Asn
260 265 270

Asn Glu Ala Pro Ser Glu Cys Pro Ala Gln Pro Lys Cys Thr Tyr Glu
275 280 285

Asn Val Thr Gly Gly Leu Trp Arg Gly Ala Gly Trp Arg Leu Ser Pro
290 295 300

Glu Glu Pro Gly Trp Asn Gly Leu Ala His Arg Arg Ala Ala Leu Leu
305 310 315 320

His Tyr Glu Asn Leu Pro Pro Leu Pro Pro Val Trp Glu Ser Gln Ala
325 330 335

Gln Gln Leu Gly Gly Glu Ala Gly Asp Asp Gly Asp Ser Arg Asp Gly
340 345 350

Leu Thr Pro Ser Ser Asn Gly Phe Pro Asp Gly Glu Glu Asp Glu Thr
355 360 365

Pro Leu Gln Lys Pro Thr Ser Thr Arg Ala Ala Ile Arg Ser His Gly
370 375 380

Ser Phe Pro Val Pro Leu Thr Arg Arg Arg Gly Ser Pro Arg Val Phe
385 390 395 400

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Asn Phe Asp Phe Arg Arg Pro Gly Pro Glu Pro Pro Arg Gln Leu Asn
405 410 415

Tyr Ile Gln Val Glu Leu Lys Gly Trp Gly Gly Asp Arg Pro Lys Gly
420 425 430

Pro Gln Asn Pro Ser Ser Pro Gln Ala Pro Met Pro Thr Thr His Pro
435 440 445

Ala Arg Ser Ser Asp Ser Tyr Ala Val Ile Asp Leu Lys Lys Thr Val
450 455 460

Ala Met Ser Asn Leu Gln Arg Ala Leu Pro Arg Asp Asp Gly Thr Ala
465 470 475 480

Arg Lys Thr Arg His Asn Ser Thr Asp Leu Pro Leu
485 490

<210> 2
<211> 491
<212> PRT
<213> mouse

<220>
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<223> FRS3 from mouse

<400> 2

Met Gly Ser Cys Trp Ser Cys Leu Asp Arg Asp Ser Val Pro His Asn
1 5 10 15

His Pro Thr Lys Phe Lys Val Thr Asn Val Asp Asp Glu Gly Val Glu
20 25 30

Leu Gly Ser Gly Val Met Glu Leu Thr Gln Ser Glu Leu Val Leu His
35 40 45

Leu His Gln Arg Glu Ala Val Arg Trp Pro Tyr Leu Cys Leu Arg Arg
50 55 60

Tyr Gly Tyr Asp Ser Asn Leu Phe Ser Phe Glu Ser Gly Arg Arg Cys
65 70 75 80

Gln Thr Gly Gln Gly Ile Phe Ala Phe Lys Cys Ser Arg Ala Glu Asp
85 90 95

Ile Phe Asn Leu Leu Gln Asp Leu Met Gln Cys Asn Ser Ile Asn Val
100 105 110

Thr Glu Glu Pro Val Ile Ile Thr Arg Ser Ser His Pro Pro Glu Leu
115 120 125

Asp Leu Pro Arg Gly Pro Pro Gln Pro Ala Gly Tyr Thr Val Ser Gly
130 135 140

Phe Ser Asn Gly Phe Pro Gly Cys Pro Gly Glu Gly Pro Arg Phe Ser
145 150 155 160

Ala Pro Arg Arg Pro Ser Thr Ser Ser Leu Arg His Pro Ser Pro Gly
165 170 175

Glu Glu Ser Thr His Thr Leu Ile Ala Ser Glu Glu Gln Ser His Thr
180 185 190

Tyr Val Asn Thr Pro Thr Gly Asp Glu Asp Gly Arg Ser Arg His Cys
195 200 205

Leu Gln Pro Leu Pro Glu Gly Arg Val Pro Leu Pro Ala Gln Thr Gln
210 215 220

Gly Ser Asp Gln Arg Asp Pro Gln Val Leu Leu Gln Pro Gly Gln Val
225 230 235 240

Lys Phe Val Leu Gly Pro Thr Pro Ala Arg Arg Gln Val Met Lys Cys
245 250 255

Gln Ser Leu Cys Pro Gly Met Gln Asp Pro Pro His His Asn Asn Asn
260 265 270

Glu Gly Pro Ser Glu Cys Pro Ala Gln Pro Lys Cys Thr Tyr Glu Asn
275 280 285

Val Ser Gly Gly Leu Gln Gln Gly Ala Gly Trp Arg Leu Ser Pro Glu
290 295 300

Glu Arg Gly Trp Ser Gly Leu Ala His Arg Arg Ala Ala Leu Leu His
305 310 315 320

Tyr Glu Asn Leu Pro Pro Leu Pro Pro Val Trp Glu Ser Gln Gly Gln
325 330 335

Gln Pro Gly Gly Glu Ala Gly Asp Asp Gly Asp Ser Arg Asp Gly Leu
340 345 350

Thr Pro Ser Ser Asn Gly Phe Pro Asp Gly Glu Glu Asp Glu Thr Pro
355 360 365

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Leu Gln Lys Pro Thr Ser Thr Arg Ala Ser Ala Arg Ser His Ser Gly
370 375 380

Phe Pro Val Pro Leu Thr Arg Arg Arg Gly Ser Pro Arg Val Phe Asn
385 390 395 400

Phe Asp Phe Arg Arg Gln Gly Pro Glu Pro Pro Arg Gln Leu Asn Tyr
405 410 415

Ile Gln Val Glu Leu Lys Gly Trp Gly Thr Ala Arg Pro Lys Gly Pro
420 425 430

Gln Asn Pro Ser Val Ser Gly Ala Pro Gly Pro Thr Pro His Pro Val
435 440 445

Arg Ser Ser Asp Ser Tyr Ala Val Ile Asp Leu Lys Lys Thr Ala Ala
450 455 460

Met Ser Asp Leu Gln Arg Ala Leu Pro Arg Asp Asp Gly Ala Val Arg
465 470 475 480

Lys Thr Arg His Asn Ser Thr Asp Leu Pro Leu
485 490

<210> 3
<211> 508
<212> PRT
<213> human

<220>
<221> misc_feature
<223> FRS2 from human

<400> 3

Met Gly Ser Cys Cys Ser Cys Pro Asp Lys Asp Thr Val Pro Asp Asn
1 5 10 15

His Arg Asn Lys Phe Lys Val Ile Asn Val Asp Asp Asp Gly Asn Glu
20 25 30

Leu Gly Ser Gly Ile Met Glu Leu Thr Asp Thr Glu Leu Ile Leu Tyr
35 40 45

Thr Arg Lys Arg Asp Ser Val Lys Trp His Tyr Leu Cys Leu Arg Arg
50 55 60

Tyr Gly Tyr Asp Ser Asn Leu Phe Ser Phe Glu Ser Gly Arg Arg Cys
65 70 75 80

Gln Thr Gly Gln Gly Ile Phe Ala Phe Lys Cys Ala Arg Ala Glu Glu
85 90 95

Leu Phe Asn Met Leu Gln Glu Ile Met Gln Asn Asn Ser Ile Asn Val
100 105 110

Val Glu Glu Pro Val Val Glu Arg Asn Asn His Gln Thr Glu Leu Glu
115 120 125

Val Pro Arg Thr Pro Arg Thr Pro Thr Thr Pro Gly Phe Ala Ala Gln
130 135 140

Asn Leu Pro Asn Gly Tyr Pro Arg Tyr Pro Ser Phe Gly Asp Ala Ser
145 150 155 160

Ser His Pro Ser Ser Arg His Pro Ser Val Gly Ser Ala Arg Leu Pro
165 170 175

Ser Val Gly Glu Glu Ser Thr His Pro Leu Leu Val Ala Glu Glu Gln
180 185 190

Val His Thr Tyr Val Asn Thr Thr Gly Val Gln Glu Glu Arg Lys Asn
195 200 205

Arg Thr Ser Val His Val Pro Leu Glu Ala Arg Val Ser Asn Ala Glu
210 215 220

Ser Ser Thr Pro Lys Glu Glu Pro Ser Ser Ile Glu Asp Arg Asp Pro
225 230 235 240

Gln Ile Leu Leu Glu Pro Glu Gly Val Lys Phe Val Leu Gly Pro Thr
245 250 255

Pro Val Gln Lys Gln Leu Met Glu Lys Glu Lys Leu Glu Gln Leu Gly
260 265 270

Arg Asp Gln Val Ser Gly Ser Gly Ala Asn Asn Thr Glu Trp Asp Thr
275 280 285

Gly Tyr Asp Ser Asp Glu Arg Arg Asp Ala Pro Ser Val Asn Lys Leu
290 295 300

Val Tyr Glu Asn Ile Asn Gly Leu Ser Ile Pro Ser Ala Ser Gly Val
305 310 315 320

Arg Arg Gly Arg Leu Thr Ser Thr Ser Thr Ser Asp Thr Gln Asn Ile
325 330 335

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Asn Asn Ser Ala Gln Arg Arg Thr Ala Leu Leu Asn Tyr Glu Asn Leu
340 345 350

Pro Ser Leu Pro Pro Val Trp Glu Ala Arg Lys Leu Ser Arg Asp Glu
355 360 365

Asp Asp Asn Leu Gly Pro Lys Thr Pro Ser Leu Asn Gly Tyr His Asn
370 375 380

Asn Leu Asp Pro Met His Asn Tyr Val Asn Thr Glu Asn Val Thr Val
385 390 395 400

Pro Ala Ser Ala His Lys Ile Glu Tyr Ser Arg Arg Arg Asp Cys Thr
405 410 415

Pro Thr Val Phe Asn Phe Asp Ile Arg Arg Pro Ser Leu Glu His Arg
420 425 430

Gln Leu Asn Tyr Ile Gln Val Asp Leu Glu Gly Gly Ser Asp Ser Asp
435 440 445

Asn Pro Gln Thr Pro Lys Thr Pro Thr Thr Pro Leu Pro Gln Thr Pro
450 455 460

Thr Arg Arg Thr Glu Leu Tyr Ala Val Ile Asp Ile Glu Arg Thr Ala
465 470 475 480

Ala Met Ser Asn Leu Gln Lys Ala Leu Pro Arg Asp Asp Gly Thr Ser
485 490 495

Arg Lys Thr Arg His Asn Ser Thr Asp Leu Pro Met
500 505

<210> 4
<211> 508
<212> PRT
<213> mouse

<220>
<221> misc_feature
<223> FRS2 from mouse

<400> 4

Met Gly Ser Cys Cys Ser Cys Pro Asp Lys Asp Thr Val Pro Asp Asn
1 5 10 15

His Arg Asn Lys Phe Lys Val Ile Asn Val Asp Asp Asp Gly Asn Glu
20 25 30

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Leu Gly Ser Gly Val Met Glu Leu Thr Asp Thr Glu Leu Ile Leu Tyr
35 40 45

Thr Arg Lys Arg Asp Ser Val Lys Trp His Tyr Leu Cys Leu Arg Arg
50 55 60

Tyr Gly Tyr Asp Ser Asn Leu Phe Ser Phe Glu Ser Gly Arg Arg Cys
65 70 75 80

Gln Thr Gly Gln Gly Ile Phe Ala Phe Lys Cys Ala Arg Ala Glu Glu
85 90 95

Leu Phe Asn Met Leu Gln Glu Ile Met Gln Asn Asn Ser Ile Asn Val
100 105 110

Val Glu Glu Pro Val Val Glu Arg Ser Ser His Gln Thr Glu Leu Glu
115 120 125

Val Pro Arg Thr Pro Arg Thr Pro Thr Thr Pro Gly Leu Gly Ala Gln
130 135 140

Asn Leu Pro Asn Gly Tyr Pro Arg Tyr Pro Ser Phe Gly Asp Ala Ser
145 150 155 160

Ser His Pro Ser Ser Arg His Pro Ser Val Gly Ser Ala Arg Leu Pro
165 170 175

Ser Val Gly Glu Glu Ser Thr His Pro Leu Leu Val Ala Glu Glu Gln
180 185 190

Val His Thr Tyr Val Asn Thr Thr Gly Val Gln Glu Glu Arg Lys Asn
195 200 205

Arg Ala Ser Val His Val Pro Pro Glu Ala Arg Val Ser Asn Ala Glu
210 215 220

Ser Asn Thr Pro Lys Glu Glu Pro Ser Asn Pro Glu Asp Arg Asp Pro
225 230 235 240

Gln Val Leu Leu Lys Pro Glu Gly Val Arg Phe Val Leu Gly Pro Thr
245 250 255

Pro Val Gln Lys Gln Leu Met Glu Lys Glu Lys Leu Glu Gln Leu Gly
260 265 270

Lys Asp Pro Val Ser Gly Ser Gly Ala Gly Asn Thr Glu Trp Asp Thr
275 280 285

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Gly Tyr Asp Ser Asp Glu Arg Arg Asp Val Pro Pro Val Asn Lys Leu
290 295 300

Val Tyr Glu Asn Ile Asn Gly Leu Ser Ile Pro Ser Ala Ser Gly Val
305 310 315 320

Arg Arg Gly Arg Leu Thr Ser Thr Ser Thr Ser Asp Thr Gln Asn Ile
325 330 335

Asn Asn Ser Ala Gln Arg Arg Pro Ala Leu Leu Asn Tyr Glu Asn Leu
340 345 350

Pro Ser Leu Pro Pro Val Trp Glu Ala Arg Lys Leu Ser Arg Asp Glu
355 360 365

Asp Asp Asn Leu Gly Pro Lys Thr Pro Ser Leu Asn Gly Tyr His Asn
370 375 380

Asn Leu Asp Pro Met His Asn Tyr Val Asn Thr Glu Asn Val Thr Val
385 390 395 400

Pro Ala Ser Ala His Lys Ile Asp Tyr Ser Lys Arg Arg Asp Cys Thr
405 410 415

Pro Thr Val Phe Asn Phe Asp Ile Arg Arg Pro Ser Leu Glu His Arg
420 425 430

Gln Leu Asn Tyr Ile Gln Val Asp Leu Glu Gly Gly Ser Asp Ser Asp
435 440 445

Asn Pro Gln Thr Pro Lys Thr Pro Thr Thr Pro Leu Pro Gln Thr Pro
450 455 460

Thr Arg Arg Thr Glu Leu Tyr Ala Val Ile Asp Ile Glu Arg Thr Ala
465 470 475 480

Ala Met Ser Asn Leu Gln Lys Ala Leu Pro Arg Asp Asp Gly Thr Ser
485 490 495

Arg Lys Thr Arg His Asn Ser Thr Asp Leu Pro Met
500 505

<210> 5
<211> 18
<212> DNA
<213> artificial

<220>
<223> synthetic DNA primer

<400> 5
agccacccaa tgctctag 18

<210> 6
<211> 24
<212> DNA
<213> artificial

<220>
<223> synthetic DNA primer

<400> 6
gtgggggcag gttctcatag tgcg 24

<210> 7
<211> 24
<212> DNA
<213> artificial

<220>
<223> synthetic DNA primer

<400> 7
agccacccaa tgctctaggc taca 24

<210> 8
<211> 24
<212> DNA
<213> artificial

<220>
<223> synthetic DNA primer

<400> 8
gtgggggcag gttctcatag tgca 24